NOAA Teacher at Sea
Mike Lynch
Onboard NOAA Ship DELAWARE II
June 20 – July 1, 2005

Daily Log

Day 1: Monday, June 20, 2005

Science and Technology Log

We are preparing for a 2pm departure on the NOAA vessel DELAWARE II. We are departing from Woods Hole Ma. Woods Hole is a small maritime community in scenic Cape Cod. Apart from being a tourist Mecca, and a jump off point to Martha's Vineyard, Woods Hole is home to some of the World's foremost institutions in the area of Oceanography and Marine Science. A brief stroll down a picturesque cape-side street takes you by The Marine Biology Libratory, the Woods Hole Oceanographic Institute, the Northeast Fisheries Center, and the National Oceanic aerospace Administration. It short order it becomes quite apparent that Woods Hole is center of learning and scientific research.

Today we will be leaving on the DELAWARE II. The DELAWARE II is a stern trawler that was built in 1963. The ship is 155ft. in length and has a displacement of 600 ton. This research vessel is operated by the National Ocean Service's (NOS) division of the National oceanic Atmospheric Administration (NOAA). NOAA is a government agency with a mandate to study the condition of the world's environments. As a steward, NOAA Fisheries has an obligation to conserve, protect and manage living marine resources in away that will ensure their continuation, while affording economic opportunities and enhancing the quality of life of the American public. Our specific mission will be a scientific survey to collect data on fishery stocks and demographics of exploited fish resources. More precisely our target stocks are to be Atlantic surf clams and ocean quahogs. In a brief orientation with our chief scientist, we were told that we would be conducting timed dredges on pre-selected stations to collect data on species recruitment, the health, number and location of incoming classes of fish. We would also be monitoring data on the abundance, location and survival rates of harvestable size clams and quahogs. Our mission will also obtain data that monitors changes in the ecosystem as well as the biomass of the surveyed areas.

In order to gain the needed scientific data, the DELAWARE II will be using a hydraulic dredge to sample the stations of the ocean bottom. The last "clam survey' was conducted in 2002. This survey is conducted on a three-year basis due to the low exploitation rate of the fishery as well as the slow recruitment rate of the species. For this survey we will be using a five foot wide hydraulic dredge, fitted with water jets, and a submersible electric pump that loosens the substrate and animals in the path of the dredge. The equipment is a

modification of that which is used in the commercial industry. The five-foot dredge looks more like mining equipment than fishing gear. It is fitted with a two inch aqua mesh that allows the capture of smaller species than are commercially profitable, in order to get a more accurate sampling of the stock. Clam debris and other associated invertebrates are collected and measured as well. Sensors and photographic equipment will also be attached to the dredge in order to measure bottom conditions and dredge performance. The state of the art sensor package placed on the dredge, gathers a continuous steam of data on dredge performance, bottom temperature, water depth and ship position. Data on catch and dredge performance; location, time and conditions will be catalogued into computer programs that will calculate stock, habitat and location.

Personal log

Day one of our journey has been a flurry of activity. We have received our berth assignments, met new people, gathered our foul weather gear and been introduced to the fantastic fare of the galley. The ship's crew is busy with a myriad of pre-departure activities, but everyone has gone out of their way to be friendly and accommodating. The weather is beautiful and everyone's spirits seem to be high. I have had the opportunity to informally interview several of the crew and was given a tour of the ALABATROSS IV as well as our ship, the DELAWARE II. The crew is busy with a cable replacement for the dredge. I and several of the volunteers had the opportunity to have a brief orientation with our
chief scientist, and we are awaiting our scheduled 2 PM departure. I will be working two shifts both from 12 to 6. The shifts, along with the scientific work, the interviews and daily logs promise to keep me busy. I am learning a lot, staying out of the way and getting excited. We will be heading south to New Jersey rather than the Georges Bank. Time constraints and equipment repair may have been factors in the change of plan. Woods Hole is a beautiful and picturesque location but also a hotbed of scientific activity.

Daily Log: Day Two

Date: 6/21/05
Latitude: 3948.669 N
Longitude: 07302.329 W
Visibility: Clear
Wind: 6-8 mph
Wave height: 1ft.
Swell Height: 3ft.
Swell Direction: 150 degrees

Science and technology log:

Changing one's hours to six on and six off could be a subject for a scientific study in itself. Our first day on board was a short one. We left Woods Hole at 3PM and began our

sail south. We stopped to do a test drop with the trawl and received a crash course in the computerized world of fishery research. The NOAA vessel uses two computer systems to monitor and catalog data while the dredge is in the water and throughout the term of the bottom dredge. Computer times are constantly calibrated to ensure that different machines are reading data at the same time. The onboard systems are the Fishery Science Computer System (FSCS), and the Scientific Communication System (SCS). The computers monitor the ship's exact, location, the time of the dredge, the speed, the water temperature the substrate composition and aspect of the dredge to the bottom. Later this week we will be attaching the video feed as well.

This sure isn't your grandpa's fishing. Once the dredge is secured to the ship, and the power is shut down the scientific crew is released to the aft deck to release and sort the contents of the dredge. The clams are sorted by variety and by size. Other invertebrates and fish are sorted weighed measured and released. The contents of the dredge are analyzed and catalogued for its overall percentage of substrate, shell debris and fish and animals. The clams are then measured, weighed and analyzed for age. The weighing and measurements are done electronically and simultaneously cataloged into the database. The ages of the clams and quahogs are determined through visual inspection of growth rings. This takes a practiced eye, especially with the ocean quahogs, which grow very slowly and can reach ages of one hundred fifty years. One of the on board scientists indicated that they will soon receive a scanner that will be able to read the rings on the surf clams and ocean quahogs and determine their precise age and growth rate. It's all pretty amazing stuff. Needless to say, some monster computer mainframe is crunching numbers and providing some great information in determining the health of the stock, the overall biomass and the condition and patterns in the environment. It's hard not to be impressed, and somewhat overwhelmed. We all have a lot to learn about our new duties onboard. We had a quick run down on other experiments we would be conducting at the request of our chief scientist throughout our adventure, and then were on our way to the Delmarva Peninsula (DELAWARE, Maryland, Virginia). We will start on our first stations at about 3 AM. This will be fishing for real, and learning on the job. We will start in the Delmarva area, and then work our way back up the New Jersey coastline. The New Jersey offshore waters are the area of the greatest concentration of surf clams and also the greatest concentration of commercial fishing. This area is of specific interest to the scientists who are anxious to measure the health of the stock in relation to findings of previous surveys. It is now 1 AM, and we are awaiting our arrival at our first station. I am spending my time reading about surf clams and ocean quahogs. I am so intrigued, I feel compelled to share. Spisula Solidissma, more commonly known as the Atlantic Surf Clam, can be found from the Gulf of St. Lawrence to Cape Hatteras. The largest concentrations are off the Delmarva Peninsula, New Jersey and the Georges Bank. Landings of clams off the coast of Virginia and New Jersey have traditionally accounted for half the landings nationwide. The Georges Bank however has been closed to commercial fishing since 1990 due to high concentrations of Panalytic Shellfish Poison (PSP). The surf clam can be found in varying depths from the beach to 60 meters, but concentrations below 40 meters tend to be low. Surf clams can reach a maximum size of 222.5cm (8.9in.), but surf clams larger than 20cm (7.9in.) are rare. Surveys are done

because clam populations can, and indeed do, move. Movement predominantly occurs in the larval period. Eggs and sperm are shed into the water column, and may bee carried by currents for as many as three weeks before recruitment to the bottom occurs. The ages of surf clams can be determined by counting the rings on their shells. The rings are formed when a thin tissue adheres to the inner surfaces of the shell, called the mantel, and a thickened rim of muscular tissue at the mantel edge deposit new material at the mantel edge. The resulting rings show how old the clam may be. More on the elusive Ocean Quahog will follow tomorrow.

Personal Log

Who the heck sits up reading about clams at one AM? Is this nuts or what? The life of a scientist is indeed a crazy one. I myself do not qualify as a scientist, but they sure are interesting to hang out with. I am learning tons, and anxious for our day to begin. The food is great, everyone is friendly, but the sleeping part is somewhat sketchy. I'm sure it will catch up with us all pretty darn soon.

Signing off, Mike (AKA, dad, Mr. Lynch, etc...)

Daily Log: Day Three
Date 6/23/05
Latitude: 3726.163N
Longitude: 07444.980W
Wave Height: 1 foot
Swell Height: 1 Foot
Weather: clear
Visibility: unlimited
Wind Speed: 7 mph

Scientific Log:
Our first real shift for the DELAWARE II Ocean Clam Survey began this morning off the coast of Long Island. The shift stated at midnight, so we were awaked at 11: 15. Our first dredge occurred at 2:15 AM. We are working in a crew of six. Two of us input data into the FSCS computer as the deck crew coordinates with the boson in charge of the winch. Safety is a big issue on the NOAA vessel, and scientists are not allowed on deck while the dredge is being lowered off the stern. A high voltage cable is fed out along with the winch cable, and no one is allowed ion the deck until the dredge is in position for tow. Our job upstairs is to coordinate with the Officer of the Day when each step is being done and input his into the computer. Each actual tow takes five minutes, but the entire process of lowering the dredge, dredging and raising the dredge onto the deck takes about 25 minutes. When the dredge is brought up, our job begins, We often start by places a smaller mesh screen at the front of the dredge in order tot capture the contents and releasing the dredge into a tow to wash away some of the debris and substrate soil. When the dredge is brought in the second time it is hauled up to an enormous table where the contents are released for inspection of our crew. It is then our task to sort through large amounts of shell hash, rock and substrate and find the living organisms. Our trawl today

has been averaging at depths of 60 meters (180ft. or 30 fathoms in you want to be really cool and nautical). This is Ocean Quahog territory. True to form, our first three station trawls resulted in large numbers of Ocean quahogs as well as the assorted species. For commercial fisherman, these other species are often referred to as discard. These are unwanted species, or at least not the targeted stock. Today along with the quahogs, we caught several varieties of clams. These smaller clams were varieties such as Asterias, Astarte, Astrope, and Razor. We also collected Sea Scallops and Horse mussels. We found the occasional Hermit Crab as well as Moon Snails and a variety of conch named Stimpson's Whelk. We captured a multitude of Astropes, a variety of spiny starfish. Few fish are caught in bottom dredges, but we did catch one small Sea Robin and a small Skate. At first, I thought the unwanted species were called by-catch, but through interviews with on board fishermen and scientists I was informed that the term by-catch more commonly refers to sea mammals, reptiles or marine birds that are accidentally caught or killed in commercial fishing. For example, in the area of scallop dredging, there has been a great deal of controversy surrounding the by catch of endangered species of Sea Turtles. After each tow the catch was sorted, measured for length, and weight and catalogued into the computer database. What used to be done by pencil and paper is now done via electronic scans and scales. For quahogs under 40 mm, or above 110 mm in length, we conducted meat weigh measurements as well. This is hard work, and the ship conducts non-stop tows and data collection 24 hours a day. We are learning fast and having fun. The six-hour shift flew by and I was exhausted. A great morning, in bed by 7AM, and ready for the next shift at 11:30 AM. What a weird schedule. We have all been at it for a day and a half, and no one seems to know what day it is.

As part of today's log, I need to share what I have learned about the mysterious Ocean Quahog. The IO\Ocean Quahog, (Antica Islandica) is found from Newfoundland to Cape Hatteras. They are usually found in depths from 8 to 256 meters. They are a relatively cold-water species and are rarely found in waters above 16 degrees Celsius. Their population densities are greater in off shore waters and they prefer a substrate of fine sand. In Maine they are found in shallower waters, but the populations are small, and the species grows at a slower rate. The average size is about 70mm. But today we had one at 110mm. What are really incredible about Ocean Quahogs are their ages. The scientists we interviewed today estimated that most of the many of bushels of quahogs we captured were in the 45 year old range. Quahogs can be in excess of 170 years old. Their most dramatic growth occurs in their first twenty years of life and the growth process slows significantly. Their ages are incredible, I may have to feel guilty the next time I spoon into clam chowder. Marine biologists have been finding that the Ocean Quahog, like the Atlantic Surf Clam, has shifting population strata. Surveys conducted over the past two decades and commercial fishing statistics show a pattern in which the Surf Clams are establishing themselves in deeper areas where quahogs previously predominated, and that the quahog populations are showing patterns of migration further offshore and further to the North. One scientist onboard speculated that clam and quahog surveys might be important in the study of global warming. Ocean Quahogs have a commercial market value. The principal commercial fishing for the species occurs off the Delmarva Peninsula, New Jersey, Long Island and even Southern New England. In 1993, the commercial harvest of Quahogs reached its zenith at 25,000 metric tons. In 2000, the

harvest had diminished to 14,000 metric tons. The decline in the fishery has been in part due to increased regulations under the Surf Clam- Ocean Quahog Fishery Management Plan (FPM), but also due to a decrease in the number of clamming boats and a depressed commercial market. Despite the reduction in total landings, the Quahog stock may be in jeopardy. The total landings are less than two percent of the total environmental stock, but any greater landings may threaten replacement levels and sustainability of this slow growing species.

Personal Log:
Things were going along well until electrical problems with the dredge shut us down. Time to go to work on a different sort of problem.

Signing off, Mike

Daily Log: Day Four

Date 6/24/05
Latitude: 3651.23N
Longitude: 07526.591W
Wave Height: 1 foot
Swell Height: 2 Foot
Weather: clear
Visibility: unlimited
Wind Speed: 14 mph

Scientific Log:
It is now 12 AM Wednesday morning. We were awakened for our shift at11:20. The unwritten rule aboard ship is that you hustle out and relieve the alternate shift a few minutes early. Things got a little chaotic prior to the end of our second shift on Tuesday. An electrical junction box that operates the high compression pump and water jets on the dredge was damaged on a tow. The electrical wiring was pulled out of the box, allowing water and sand to impregnate the electrical system. The damage was observed prior to the dredge being lowered for another tow, and the work began. Life at sea requires the crew to wear many hats. There is no Wall Mart, no Home Depot, no 911, no fire department, and no ambulance. We are a self-sufficient community that must be self reliant and work as a team in order to problem solve. Tools were brought out, electrical parts were on hand and collective, hands on, can do attitude was applied. The box was repaired and I learned a good deal about how electrical work designed for underwater usage, differs significantly from what is done on dry land. This event prompted me to think about the interesting and challenging aspects of life at sea. Today's journal log will focus on the job of safety. Starting the first day, we were all assigned fire stations, evacuation stations, general quarters assignments and given safety protocols. Before we left the dock, we had our first fire drill. We were also instructed to go to our evacuation stations and to bring our immersion suits. Everyone was asked to put his or her immersion suit on. It was a fine photographic moment, but also a very serious one. While on a tour of the Osprey IV, prior to our departure, one of our officers pointed out the self-contained oxygen apparatus

for fire fighting. In passing, he mentioned, “you know, if we have a fire out here, there’s no one to call”. Every one of our staterooms has four bunks a bathroom, four drawers and small lockers for your stuff. There are usually never more than two in the room at any time due to watch constraints. But regardless of the constraints on space, each room contains a fire extinguisher, four Emergency Escape Breathing Devices (EEBDs), four life jackets with beacons and two survival (immersion) suits. The “common room” which adjoins the galley is no bigger than 6ft.by 12ft. There is a TV, a stereo, VCR and two couches. Space is limited, but central to it all are an EMT jump box for medical emergencies and an automatic emergency defibrillator for possible heart attacks. In the same room, there is a posting of all crewmembers and their stations and responsibilities in foreseeable crisis events. There are drills for fire, abandon ship, and man overboard. Each of these drills has an associated general stations alarm and whistle designation to identify the nature of the crisis. Hardhats are worn on deck at all times and OSHA regulations for safety are strictly followed throughout the vessel, Immediately inside the stern deck are two emergency showers with eye wash stations. There is a chemical spill kit inside the ready room. There are full-size backboards and short boards dispersed throughout the ship for immobilization involving head trauma or possible spinal compromise. Before boarding the ship, I observed twos stokes basket that would be used for emergency lift of a diver out of the water, or an overboard crewmember. There is also a contingency on board for an emergency helicopter evacuation. There are nine general fire stations throughout the boat that have hydrants and hoses. There are four life rafts that can be used for evacuation and one rescue vessel that can be used for emergency retrieval of a person overboard. There is a dive locker with underwater breathing apparatus and trained personnel to make the dives. There is a Damage Control Locker that contains three SBA controlled breathing devices and fire suits in case of an onboard fire, as well as HAZMAT materials, and myriad of resources that would be necessary in the event of a collision. On each of the outside decks, there are life rings with locator beacons stationed to be used for a man overboard scenario. There are a total of eight Life rings, six of which have locator beacons. At night, personnel are instructed to continue to release these in order that the ship can find a path back to the crewmember. There are a total of forty-five fire extinguishers onboard. They are a variety of water, CO2 and chemical. There is a chief medical officer and three other officers are current EMTs. All crew, commissioned and civilian have basic first aid training, current CPR, and are routinely presented with safety seminars on ship board policy, firefighting and the use of available equipment such as the emergency defibrillator. At first, these drills and musters, seem to be mere bureaucratic
protocol, but when you are at sea for a period, and realize the physical isolation that separates the vessel from services that we have all come to take for granted, you come to realize the nature of being at sea. For me, it was the repair of an electrical box that opened my eyes to the true interdependence that makes a crew a self-sustaining community.

Personal Log:
The morning shift from 12 to 6 was great. Temperatures were comfortable and the moonlight made to ocean absolutely beautiful Breakfast at six and back to bed. Up at eleven and work to six. Our tows have been moderately successful and we have been

keeping busy. I am still operating the shipboard computer for each of the events, and that seems to be a lot easier now with practice. The food is great, but the hours to eat, in proximity to sleep, are all out of whack. This afternoon I suddenly started to get really tired. The whole crew is going through a metamorphosis where the intense curve of learning is beginning to be replaced by an overall fatigue. I am certain that will improve as we acclimatize to our schedules. There is another teacher on board, but on the other shift. We are comparing notes as we pass. One of us has always just gotten up and the other has just finished a shift and is heading for the barn. I did a lot of interviewing today, some on a formal basis and a lot of informal questioning of officers, scientists and crew. My clothes are a mess and wash will soon become a reality. The general rule is to wait until you have a full load, as water is a manmade commodity on the DELAWARE II.

Signing Off, Mike, dad, AKA Mr. Lynch

Daily Log: Day Six

Date 6/26/05
Latitude: 3858.760 N
Longitude: 07407.744 W
Wave Height: 1 foot
Swell Height: 2 Foot
Weather: clear
Visibility: unlimited
Wind Speed: 4 mph

Science Log:
As we are entering our sixth day aboard the DELAWARE II, we are still collecting data on Atlantic Surf Clams and Ocean Quahogs. It could be that some would question why NOAA, the Federal government, scientists and the commercial industry would be so interested in these species as to fund our research. Today's log will try to deal with some of the reasons that make this and other surveys of this type important. The citizens of the United States and the World depend on marine resources for jobs, recreation, tourism, medicine and industrial and commercial products. As citizens, we depend on our governments to make informed policy decisions to ensure sustainable resources for future generations while allowing for present well-being and opportunity. These goals may sometimes appear to be at odds, but on further analysis they are interrelated. At no period in history has mankind been so acutely aware of the correlation between environment and human well-being. The result of this awareness has placed increased public pressure on NOAA to provide optimal stewardship of these resources. NOAA and the Northeast Fishery Science Center have established goals that attempt to reach a balance between conservation for the future and efficient utilization of existing resources. The first goal centers on research and monitoring. This is where the scientific surveys, such as the Clam Survey provide data that helps our society to understand and predict changes in the ecosystems and their subsystems that affect vital marine resources. The second goal is to provide scientific advice that can be used to create sound environmental policies with an ecosystem framework. This advice is provided in order to enhance society's ability

foresee and respond to changes and manage risks. The third goal deals with education and outreach. Communication with individuals, stakeholders, schools, communities and industry is essential if policy and regulations are to be formulated and adhered to. Cooperation can only be achieved through communication and participation. Our current survey, and my participation as a Teacher at Sea are prime examples of NOAA's commitment to share technical assistance and understanding. Another example of NOAA's adherence to the goals of conducting and disseminating scientific data have been the Cooperative Clam surveys conducted in 2002, 2004, and soon to be continued in July of 2005. Two of the scientists that participated in the 2004 Cooperative Survey are currently on board our current Clam Survey. Both were happy and enthusiastic to share their experiences and are anxiously awaiting their participation in this years' 2005 Cooperative Research.

The Atlantic Surfclam supports a multi million dollar annual fishery along the Mid-Atlantic Coast. Communities, industry, fishermen and the general population are stakeholders in these important resources. Preserving the well being of the surfclam fishery is therefore not solely an objective of environmental agencies. Due to concerns about the status of the surfclam stock, the Cooperative Clam Surveys were developed to augment the scientific surveys that were being done by NOAA every three years. The surveys that doctors Pickett and Nordahl worked on were cooperative efforts of NOAA, the National Fisheries Institute, The Clam Institute, the North Atlantic Clam Association, The New Jersey Fisheries Information and Development Center, the Rutgers University Haskins Shellfish Research Laboratory and the University of Virginia Institute of Marine Science have worked cooperatively to conduct these surveys. The survey area was the Mid-Atlantic Coast from the Hudson Canyon to Virginia. This survey, however had a noticeable difference, a commercial clammer, the FV Lisa Kim was used, as well as a commercial clam dredge. The same Stratified Random Sampling Design, utilizing NEFSC clam strata was used as had been done on the DELAWARE II three year Clam Survey. Dredge efficiency was measured via depletion experiments and monitored by using the NMFS Survey Sensor Package (SSP) from the DELAWARE II. Results from the 2004 survey were catalogued and compared with historical survey data. Tows were made on the same random stations, using the same speed, the same tow duration, and the same count and measurement techniques were employed. The differences were the ship, the dredge and the expertise of professional clammers. Due to the lesser number of scientists on board, measurements of ages, Ocean Quahogs, Southern Quahogs and clappers were not taken. The results in some ways confirmed data that had been accumulated by the DELAWARE II. The research confirmed the patterns of surfclam population movement to deeper waters and a distinct northern migration pattern. Numbers of clams caught suggested that clam populations might be greater than had been previously suggested. Most importantly, the survey produced a sampling of data that allowed the NEFSC to compare their data with scientific data cooperatively produced with participating stakeholders. The data collected by the commercial vessel can now be used to quantify the efficiency of the equipment and procedures used by the DELAWARE II.

True to the goals of NOAA Fisheries, industry, scientists and government are working in coordination to create accurate data from which we can make informed decisions to

benefit our present economic needs and the future of our precious marine environments. NOAA has in many ways accomplished its goal of outreach, cooperation and education. By empowering stakeholders and informing society, the future looks bright for the creation of policy and regulations that achieve the balance of present and future needs. Personal Log: The weather is absolutely outstanding. Calm seas, a slight breeze, moderate to warm temperatures and little humidity, does it get any better? We are starting to become adjusted to our new sleep patters, and the equipment has required little servicing. We are currently off the coast of Virginia. Have I mentioned the food is great? Everyone's favorite person is the Chief Steward. The only thing missing… Clams! Oh well, we're finding where their not.

Signing Off, Mike, dad, AKA. Mr. Lynch

Daily Log: Day Seven

Date 6/26/05
Latitude: 3953.84 N
Longitude: 07354.58 W
Wave Height: 1 foot
Swell Height: 1 Foot
Weather: partly cloudy
Visibility: unlimited
Wind Speed: 4 mph

Science and Technology Log
Today's log will be an outline of a typical day aboard the DELAWARE II Clam Survey. Our day begins with an 11:10 wakeup call. A quick routine and I am out the door. Coffee in the galley, a few guys watching the final minutes of game seven of the NBA finals. I quickly take advantage of the time to organize my folder of materials that has fallen into disarray. There is very little space other than the galley to do any written work on board. Every available space is filled with equipment of some sort related to our survey. There are no tables or chairs in our staterooms, these are only for sleeping. It's now 11:50 PM, and time to go aft to relieve the other crew. There are six people on this crew, and they are all busy measuring clams and weighing meat weights. They are happy to see us and noticeably tired. Within minutes, we are coming on to our first station. Stations are either randomly selected by the computer or selected by our chief scientist. Unlike a commercial fisher, we survey many different strata and depths. We are not exclusively concerned with the areas of highest concentration of biomass, but instead want to obtain data that will give an overall glimpse of the entire ecosystem. It is my job to go up to the bridge as we approach the station and coordinate the Shipboard Computer System (SCS) with the activities of the deck crew and the Officer On the Duty (OOD). This morning, Ensign Nathan Priester, Navigator, is on duty.

The first activity on the SCS is to synchronize the computer clock to a constant satellite feed and software called Dimension Four. Once I am assured that the computer clock has

not drifted I open the program software to the clam survey data. This screen requires that I enter information that will catalog the data for each specific event at designated areas called stations. Station numbers are related to exact coordinates of latitude and longitude for the desired tow. Today we are off the coast of Virginia at Latitude: 33651.231N. Longitude: 07526.591W. Next to be entered are the numbers for strata (general area) and the tow number (the number of tows in that strata). The computer will then use this data to not only monitor the aspects of the tow, but also as a file to catalogue the species data that will later be recorded on deck. The next information has to do with the depth of the tow. A number is entered that correlates to the length of the hauser that is to be released. A hauser is a 3" rope that is used to tow the dredge once it is on the bottom. Today the hauser length will be 110 ft.; I also need to enter the information for the winch cable. The winch cable is heavy wire that is used to lower and raise the dredge. The length out is slightly longer than the designated hauser length; this means that when the dredge reaches the bottom the tension is transferred over to the more flexible hauser for the tow. Today's cable information is designated 125 ft and the Crane. Having entered this info, my next job is to go to the back of the bridge and activate two switches that will lower the hydrophone. This is a device that is lowered down beneath the ship that communicates with the Survey Sensor Package (SSP) adhered to the dredge. This sensor package provides a constant stream of information regarding dredge position, attitude to the bottom, speed, depth, temperature, and more. This communication will also provide a track line that can be monitored on the bridge and the wet lab. Now we are ready for a tow. At this point, I take my cues from the officer on duty and the deck crew. The deck crew is on the radio and the OOD, on the bridge, has a video feed of the stern deck. The crew calls in that the dredge is being taken off the chains, and I input the start of the "event" in the computer. An internal clock starts running and monitoring data. When the dredge is 10 meters out the crew asks for "Power On", I now enter this into the SCS, and the 440-volt power is turned on to the pump and the sensor package. At this point the sensor package is being read by the hydrophone, and a constant stream of data is being entered. The pump is now delivering water at high pressure through a manifold with a dozen nozzles. This pressurized water is blown onto the substrate (ocean floor) creating a slurry of clams, substrate and shell hash in front of the oncoming dredge. When the dredge comes to the end of the cable, the tension is transferred to the shorter hauser line and the crew announces "on the hauser". This is my cue to enter "start tow". This command starts an internal clock that measures a tow of exactly five minutes. With five minutes to spare, I now need to enter further cruise information and input weather data. The OOD keeps the vessel going a constant 1.3 knots. He then tells me the average rpm of the tow. Today we are averaging 135 rpm's. The weather data consists of the percentage of cloud cover (20%), the visibility (clear), the wave height (2ft.), the swell height (3ft.) and the swell direction (160 degrees). At the end of the five-minute tow, the deck crew announces, "haul back", and I input "end timed tow". The next command I input will indicate off the hauser, meaning that the cable winch has now retrieved the tension. The next command is 'off the bottom", and then power off. When I input each of these commands into the computer I await the call for last ten meters. This signals the end of the computer event and I exit the program, cross off the station on the log so that the number is not inadvertently reused, and electronically retrieve the audio phone back

onboard. This part of my job usually takes about 25 to 20 minutes. It is now time to go aft, put on my oilers, and go out to sort the dredge contents, and input species data. That will be the subject of a future log. This process is repeated on an average of eight times per shift. There are four shifts; each crew has two shifts per day. The vessel and data collection operates 24 hours per day.

Personal Log:
We are now off the coast of Virginia. There is lots of military traffic out of Norfolk. We are fishing the shallower waters of the Delmarva Peninsula. We are in surfclam territory. We are having limited success which is consistent with the data of previous surveys that would suggest that clam populations are moving to colder off shore locations and further north. We are doing a lot of measurements of meat weight and saving samples in various strata for Universities and scientists that have requested samples for research. All is well, the weather is great the people on board are super, and, have I mentioned the food is great?

Signing Out, Mike, dad, AKA. Mr. Lynch

Daily Log: Day Eight
DELAWARE II Clam Survey
Teacher at Sea: Michael Lynch
Date 6/27/05
Latitude: 3938.834N
Longitude07316.810W
Wave Height: 1 foot
Swell Height: 3 Foot
Weather: cloudy
Visibility: obscured
Wind Speed: 14 mph

Science and Technology Log:

Today's log will continue the exploration of the DELAWARE II, her crew, and the concept of an ocean going vessel as a self-reliant community. This log, like the last on this theme, as inspired by a sudden revelation; Clams can be stinky. Actually, clams themselves probably aren't all that stinky, but constant application to clothing over a prolonged period of time at accelerated temperature certainly produce stink. Having come to this hypothesis, I concluded that the solution was laundry. (Pretty scientific, huh?)

Laundry on board the DELAWARE II, in itself, doesn't pose a large problem. You wait until about 2 AM, go down past the galley and into the Ship's Store, and you find two sets of washers and driers. Simple, there is really nothing to it, until you begin to investigate the processes that are involved in providing laundry service. Where does all the fresh water come from? How does the onboard electrical system work? Where does the wastewater and soap go? To find answers to these questions I interviewed Lieutenant Jeff Taylor, who is scheduled to become the X.O. (First Officer) off the DELAWARE II.

The first question dealt with fresh water. “Water, water everywhere, but not a drop to drink”. I’m not exactly sure who said that, but it pretty much explains where we are. We have not seen land in over a week, so where is all this fresh water coming from? Lieutenant Taylor explained the process. Fresh water is used onboard for drinking, washing, cooking, and of course, laundry. Initially the answer is simple, 5,000 gallons of water is taken onboard when dockside. This water is supplied to different areas of the ship using an electrical pumping system; the electricity is supplied by generators that are powered by diesel... simple! But what happens when we start to deplete the water? The answer to this is an onboard water purification process that uses an evaporation system to create fresh water. Jeff explained that sea water was taken onboard through what are called sea chests. The seawater is then run through coils that are heated to boiling by the diesel power plant that powers the ship. The resulting steam produces fresh water and the remaining salt solution is returned to whence it came. Simple, we have just distilled fresh water from salt. The newly created water is now pumped into the holding tanks to replenish the water source. The potable water tank is subjected to a bromine treatment, and we are good to do laundry. The creation of fresh water in this manner really is a big deal. It in essence removes one of the three elements that limit the time a ship may stay out at sea: water, food, and fuel. Fresh water is in constant supply to the thirty-man crew of the ship. Fresh water is pumped to each of the staterooms, two common bathrooms, the galley, the ship’s store, the emergency showers, and the wet deck in the science area. The nine fire stations and the onboard hydrants on each of the decks use seawater.

The second question deals with power generation. Power generation onboard the DELAWARE II is supplied by two “Ship’s Service Generators”. These are diesel powered 375 amp generators. On this survey, one of the generators is used to power the ship’s electrical needs and the other is dedicated to the Clam Survey equipment, primarily the winches and the 440 service to the underwater pump. Usually only one generation is used
at a time, and run for 250 hours between oil changes. There is also an emergency generator onboard that supplies a 70-amp service. The generators, as well as the ship’s two powerful engines are diesel powered. The ship’s diesel capacity is approximately 4o,ooo gallons, enough for 19 days at full operation, 24 hours a day.

The last component of the laundry equation is the matter of wastewater. There are two distinct wastewater systems onboard the DELAWARE II. These are “grey water” and “black water” systems. Grey water comes from sinks, showers, and laundry. Disposal of grey water is a simple enough process, it can be pumped overboard. The Environmental Protection Agency and the United States Coast Guard, however, strictly regulate black water, or human waste disposal. No black water may be disposed of within three miles of the United States’ coastline. Beyond three miles, processed waste may be disposed of, and beyond the twelve-mile mark; untreated human waste may be pumped overboard. Aboard the DELAWARE II, a Marine Sanitation Device (MSD) treats all black water. The sewage treatment is essentially a large holding tank, with a macerator. Biologicals are added (yeast), and the black water is treated and released.

There are also regulations and protocols for the disposal of garbage at sea. A wet and dry garbage log is kept on the bridge. If the galley wants to dispose of left over food, they must request permission; specify the amount, the type, the time and the day on the report. These items would fall into the category of wet garbage. For things like cardboard and paper, a similar log with similar notations is kept. For dry garbage, it must be reduced to pieces 1" or smaller if released between 3 to 12 miles of the coast. Oil and plastics can never be dumped at any location. The wet and dry garbage logs are routinely checked and cross-referenced to the materials that were taken aboard. The DELAWARE II does not dump much, if any, dry garbage, but instead uses a compactor, bags and wire gages to store the garbage for shore disposal. Well, my laundry is done, and what seems like an everyday mundane task turns out to be a wonder of applied science. Things smell better now.

Signing Off, Mike, dad, aka. Mr. Lynch

Daily Log Nine

Date 6/29/05
Latitude: 3938.834 N
Longitude: 07316.810 W
Wave Height: 2 foot
Swell Height: 3 Foot
Weather: cloudy
Visibility: eight miles
Wind Speed: 11 mph

Scientific Log:

Today's Log will focus on the scientific work being done on the stern deck. The Chief Scientist, Victor Nordahl, coordinates the 2005 Clam Survey aboard the DELAWARE II. One of Victor's many jobs is to oversee the collection work done by the two scientific crews aboard the vessel. Each crew works two six hour shifts, the scientific data collection and cataloguing goes on twenty four hours a day. Each crew is made up of a crew chief and five supporting workers. Our crew chief is Chad Keith. Chad is an engaging young man who has worked for NOAA for a number of years and has just finished his Masters degree in Geography at the University of Oregon. Kris Ohleth is our Marine Biological Seagoing Technician. Kris is soon to start her graduate program on Marine Policy at the University of Rhode Island. Kris is in charge of data and the daunting task of training people, like myself, in the intricacies of the onboard FSCS and SCS computer systems. Richard Raynes is an equipment technician for NOAA, and a net maker by trade, he is the equipment guru of our crew. Erin Kapcha is also a NOAA employee, who coordinates the observer program that places observers on board commercial fishing vessels. Erin is stretching her legs and doing some work outside the office. Cindy Travers is an energetic 20 year old, Senior Cadet from The United States Coast Guard Academy in New London Connecticut. Cindy is doing a summer practicum on board and will be following this cruise with another on board the ALABATROSS IV.

I, Mike Lynch, am the last member of the crew, and a participating member of the Teacher at Sea Program. I am a flatlander from Moses Lake Washington. I am here to learn more about the role NOAA plays in the formulation of policy and regulation. I am also here due to NOAA's commitment to education and outreach. Our mission, as we have accepted it, is to gather and input data on the Atlantic Surfclam and the Ocean Quahog. Today's journal will be a synopsis of the processes of data collection and the responsibilities of our crew.

In an earlier log, I outlined my duties on the Bridge. This was the process of reporting data for each station on the Shipboard Computer System. This is the step that monitors the location and duration of each tow of the dredge. The next step happens on the stern work deck and the wet lab.

Once the dredge is brought back to the surface, brought up on the crane carriage, and secured to the deck by the deck crew, it's show time for our science crew. Our first job is to inspect the dredge and determine if the contents need to be washed. If they do, we adhere a mesh gate to the front of the dredge and it is released by the work crew for a tow behind the boat. Once washed, the contents of the dredge are released on to a large worktable for sorting. One of our crewmembers, usually Richard, goes up into the dredge to clear it of all debris. The contents of the dredge are pulled with rakes down the length of the worktable. The crew sorts surfclams and quahogs and places each species into bushel baskets at the end of the table. Another bucket is in place for other species such as starfish, crabs, fish and other varieties of clams. Two other buckets are in place for broken clams and quahogs, and clappers. Clappers are clams or quahog shells that are still intact and connected, suggesting the animal is only recently deceased. The debris, called shell hash, is also collected into bushel baskets. Once the table is cleared, it is time to clean the dredge area, count the baskets of shell hash, and catalogue the species data into the FSCS database. Ocean quahogs and surfclams are taken and weighed on electronic scales. The scales have been calibrated to zero for the weight of the bushel basket. The clams are then moved to one of three workstations. The stations are long stainless steel tables equipped with Limnos boards, electronic scales and interactive FSCS computer monitors. The limnos boards are used to electronically measure the length of each specimen and catalogue the data into the database. The scales are used to measure the specimen weight in shell and the meat weight of shucked specimens. The computer terminals are touch screens that are interactive consoles, which allow the recorder to select species and data categories. The console also notifies the worker of special instructions and requests for specimen samples that have been requested by the chief scientists. The species are catalogued by station, which has been programmed at the bridge to indicate exact location, time, depth, weather, etc.

For the purpose of data collection, the areas that we are investigating are divided into regions and strata. The Clam Survey is collecting data in five regions: Georges Bank, Southern New England, Long Island, New Jersey and the Delmarva Peninsula (an off shore area of Delaware, Maryland, and Virginia). We are participating on the third leg of the survey, and have spent most our time, thus far, off the coast of Virginia. These large

geographical regions are subdivided into smaller areas called strata, and the specific areas of each tow are called stations. In each of the strata, we are asked to collect age data and meat weights as well as numbers and weight volumes. For Ocean Quahogs, we are asked to collect meat weights and samples of ten specimens for each 10 mm. class in length measurement. These samples are shucked weighed, catalogued for the location of their capture, bagged, labeled and frozen. These will go to Jim Weinberg, who is the Principle Investigator for this survey. Essentially these samples are to be analyzed in the NEFSC labs in Woods Hole. Atlantic Surfclams receive far greater scrutiny. Samples of meat weights must be kept for specimens within 10mm. classes on every tow. The requests for these samples are preprogrammed into the computer base, and as the "cutter" enters the length on the Limnos board into the computer, the recorder will be told which specimens must be kept for meat weight collection. The NEFSC division of Age and Growth also requests Surf Clams. The computer will alert the recorder that an age tag is requested. In this scenario, The cutter will take a meat sample, but the actual clam shells will be marked by station number, strata, and ID number. These shells are bagged, tagged and frozen for the A&G lab. Age samples are one clam within a 10 mm class at every site. How's that for confusing. Between our crew chief Chad, our Sea going Technician Chris, and the demanding FSCS computer terminal, mere mortals like myself can participate in scientific data collection.

Aside from the data collected for the Northeast Fisheries Science Center, we are collecting surf clam samples for a member of our other crew. Adriana Picariello is collecting samples as part of research for her Masters Thesis at the University of Virginia Marine Science department. Her research will be comparing growth rates in different regions. It's interesting what you can learn from clams, about the environment and possible changes in the environment such as global warming. Cool Stuff!

Personal Log:
The weather has become hot and humid. Yesterday we did part of a depletion survey where we did repeated tows non stop for the entire shift. It was a real marathon, I could have been part of a research on the sweat capacity of a human being. There was no time for interviews, logs or breathing. I slept well! Go figure. Still having fun, and have I mentioned the food?

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Daily Log Ten

Date 6/30/05
Latitude: 4043.985 N
Longitude: 07123.307 W
Wave Height: 2 foot
Swell Height: 3 Foot
Weather: cloudy
Visibility: obscured
Wind Speed: 14 mph

Science Log
The last couple of days aboard the DELAWARE II have been a constant buzz of activity. We have moved north to the New Jersey Coast. This is prime surfclam territory, and sure enough we are into them. Our chief scientist Victor Nordahl has selected this site for a depletion survey. A depletion survey is an event that starts with finding an area of heavy population density. For our purposes and equipment, this was an area that yielded five bushels of clams in a single tow. Once the location is found, the exact GPS coordinates of longitude and latitude are used as a locator for each successive tow. Using the information recorded by the Ship's Sensor Package (SSP), the exact trackline of the tow is ascertained and becomes the template for the depletion event. The concept of the depletion is to repeatedly cover the same track line for as many as 40 to 60 tows. With each tow, clams are counted and on every fifth tow, they are measured and samples are taken. The purpose of this event is to monitor how quickly the dredge reduces the population. Through this process, the scientists can calculate the effectiveness of the equipment in capturing the species. In essence we are calibrating the equipment. In fact, we are running non-stop stations in one of the muddiest areas we have seen. It is an exhausting process that goes on 24 hours a day and works the bridge, deck crew and science teams very hard. I have developed a real respect for how strenuously this crew works. Everyone pitches in, and works as a team.

The depletion event is rapidly coming to an end. It will be followed by our last duty at sea. Our next mission will take us off the coast of Massachusetts, where we capture clams and take samples to determine the levels of Red Tide infection. Closure of fisheries for red tide, is usually a job for state agencies, but it is also an opportunity for NOAA to do further scientific research. While steaming to our destination, we are working on

swapping out the SSP package on the dredge. The second unit will be used on these final tows to ensure its reliability for future surveys. On our next watch, the DELAWARE II will be concluding the third and final leg of the Clam Survey. The ship will steam to its homeport of Woods Hole Massachusetts. The ship will be in port for four days. During this time, much of the equipment that is used in the clam survey will be disassembled and moved into storage for three years, when the next clam survey will be once again conducted by the Northeast Fisheries Science Center. The three and a half ton dredge and the Crane carriage will be stored, but other technological devices will be used in an upcoming Cooperative Survey that will be conducted in late July and early August. The DELAWARE II, however seems to never be at rest. In three days, the ship is scheduled to leave on a Marine Mammal Observation Cruise for the next two months. This survey will be conducted in order to measure and monitor marine mammals in the Georges Bank, Southern New England, Long Island, New Jersey and Delmarva Regions. An Autumn Trawl Survey will follow this. The trawl survey is a multi species finfish survey that collects biological data, such as maturity stages, food habits, predator/prey relationships and migratory patterns. This same Trawl survey will also be conducted in the spring. The regions to be surveyed will be the Mid-Atlantic (inshore and offshore), the Georges
Bank and the Gulf on Maine. This winter, the DELAWARE II will be conducting a Winter Trawl Survey that uses a modified net system that targets flatfish such as summer fluke and yellowtail flounder. The Winter Trawl Survey will focus on the Mid-Atlantic, Southern New England and the Georges Bank regions. The DELAWARE II will also participate in a Fishing Power Survey that are a series of experiments designed to yield a correction factor for changes in either survey equipment or vessels. This year the DELAWARE II will be conducting these tests with the HENRY BIGELOW, a new vessel being built in Mississippi, and scheduled to replace the DE II's sister ship, the ALABATROSS IV.

To find out where the DELAWARE II is, at any given time, NOAA provides a web site that includes a track line of all of its research vessels. Wherever these vessels are you can be assured that they are working diligently to accomplish the goals of the Northeast Fisheries Research Center. The goals start with research and monitoring fish stocks and their environments. The surveys endeavor to provide data that will assist in understanding and predicting changes in marine ecosystems, living marine resources, fisheries, habitats, ecosystem condition, and the generation of national benefits. The outcome of this research is the production and dissemination of scientific advice for management programs based on an ecosystem framework, and finally, you can be assured that NOAA will be endeavoring to engage stakeholders in the process of decision-making. NOAA is a team builder in stewardship. You can also be assured that NOAA will be involving educators in order to provide outreach to students and society at large.

In closing, I need to extend my thanks and appreciation for the opportunities that were afforded me aboard the DELAWARE II. True to NOAA's goals of education and outreach, the crew extended tremendous courtesy and patience while indoctrinating me into the area of marine science, research and life at sea. Without exception, all of the crew

were helpful and willing to share their expertise and time. I must extend particular thanks to Charles Keith, Kris Ohleth, Richard Raynes, Erin Kapcha and Jeff Taylor. Each of these crewmembers extended themselves way beyond the call of duty in helping me to understand the shipboard policies, routines and the goals and objectives of our research. Also a special thanks to Cindy Travers, a Coast Guard Cadet who taught me a great deal about seamanship and positive attitude. Each of these people embodies a dedicated spirit that goes well beyond the parameters of their specific duties. Special thanks also goes to Dennis Carey, the Chief Steward who is the most important, and hardest working person on the vessel. I also wish to extend my thanks to all aboard the DELAWARE II, the crew believes in their mission and are sacrificing personal gain for public service. In short, they are an inspiration.

Life at sea is arduous. It is hard work, long hours, inclement conditions and deprivation of creature comforts. Life at sea is also a community, a brotherhood and a commitment. To NOAA, and the crew of the DELAWARE II, thank you, I learned a great deal and am deeply grateful.

Signing off, Mike, dad, AKA. Mr. Lynch